Spring May 7th, 2012

Brainstorm: Brain Development, Part 1: Of Mops and Brain Cells and Human Behavior

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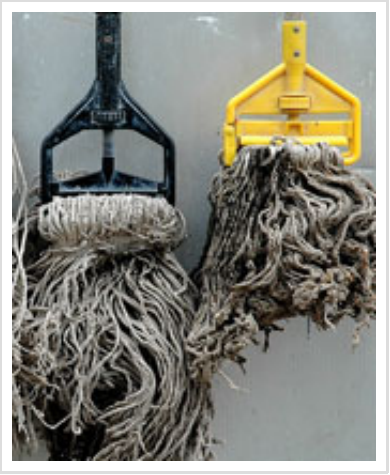
By: John Medina | Posted: May 7, 2012



We have been discussing in equal measure the contributions that both *nature*and *nurture* make in the creation of human behavior. In this entry and the next, we are going to focus on the *nature* side of the discussion, summarizing a few features about how the human brain develops in the womb.

Why get into this biology? Many people believe a complete understanding of human behavior will not occur until we have a complete understanding of the tissues undergirding it. I agree, at least in part, but I must warn you that the jury is still way out on the specifics of the relationship. Though our understanding of how womb-bound brains develop is growing by leaps and bounds daily, there are very few behaviors we can unambiguously blame on cellular developmental processes. That's not necessarily depressing; it just means you are now looking with me at the edge of what is known.

We begin by going over two cell types involved in the process.

The first cell type may be familiar to you: the *neuron*. Though neurons do most of our thinking for us, they only comprise about 10% of the total number of brain cells inside our heads. For my money, that's probably where we get the myth that you only use 10% of your brain (which by the way, is not true).

The typical neuron looks something like a frightened mop. The hairy, strand-filled, business end of this mop is called the *cell body*, and its various branching structures termed *dendrites*. The handle of the mop is the *axon*, terminating in a smaller structure, called, logically, the *axon terminus*.

Neurons form electrical circuits with each other by lining up in a terminus-of-Neuron-A associating with the dendrite-of-Neuron-B-fashion. They really aren't physically connected, however. There is a tiny space separating the two, which we call a synapse (from the Greek word *sunapsis*, which means, logically enough, point of contact). These circuits comprise the functional wiring of the mature brain.

If the neurons described above represent only 10% of the brain's cellular population, what comprises the other 90%? This seemingly silent majority population is made of our second cell variety: *glial cells*. *Glial* literally means*glue*, and for the longest time, we thought that this was the primary role of glial cells: to glue the brain together. While it is still true that glial cells provide an important scaffolding function (at 90%, how could they not?), we now know that they are not passive onlookers standing by while neurons do all the intellectual heavy lifting. Glial cells are involved in many cognitive processes not normally associated with the simple task of providing a passive structure. They are deeply involved, for example, in helping the brain to maintain its chemical "balance," which in turn assists the associated neurons to process information correctly.

So how do neurons and glia interact to form the world's greatest thinking machine? Human brain development at the cellular level can be likened to a three-act play. We will explore in greater detail each of these three acts in our next installment, but I am happy to provide the CliffsNotes version here:

- Act One involves manufacturing neurons from garden-variety embryonic cells. This is called *neurogenesis*.
- Act Two involves coaxing the neuron to snake over to the region it will eventually call home. This is appropriately called *migration* — neurons move in response to internal signals reacting to external guideposts (the site of manufacture is seldom the place of final installation).
- Act Three involves hooking up the neuron to its neighbors once it arrives at its terminal destination. This wiring is called *synaptogenesis*.

Somehow, these processes unite to form a living, thinking brain, fully capable of studying itself, fully capable of being completely unsatisfied with how little we know about it all.

Comments

2 COMMENTS TO "BRAIN DEVELOPMENT, PART 1: OF MOPS AND BRAIN CELLS AND HUMAN BEHAVIOR"

Joe says: May 9, 2012 at 3:33 pm

Great post! I never knew about glia. I'm interested to find out why neurons migrate. Wouldn't it be simpler if they just lived where they grew up?

Melode Mariner says: May 6, 2013 at 1:33 pm

Could it be that it is not obvious where the neuron should go based on massive or limited amounts of experience that the brain is keeping track of…building new pathways.

This is a whoa!!!! concept. My brain hurts.